2.1 Physical quantities and units

This section provides knowledge and understanding of physical quantities and units.

2.1.1 Physical quantities

	Learning outcomes	Additional guidance
	Learners should be able to demonstrate and apply their knowledge and understanding of:	
(a)	physical quantities have a numerical value and a unit	*M0.1*
(b)	making estimates of physical quantities listed in this specification.	*M0.4*

2.1.2 S.I. units

	Learning outcomes	Additional guidance
	Learners should be able to demonstrate and apply their knowledge and understanding of:	
(a)	Système Internationale (S.I.) base quantities and their units – mass (kg), length (m), time (s), current (A), temperature (K), amount of substance (mol)	HSW8
(b)	derived units of S.I. base units	Examples: momentum $\longrightarrow$ kg m s^{-1} and density $\longrightarrow$ kg m^{-3}
(c)	units listed in this specification	
(d)	checking the homogeneity of physical equations using S.I. base units	
(e)	prefixes and their symbols to indicate decimal submultiples or multiples of units – pico (p), nano (n), micro (μ), milli (m), centi (c), deci (d), kilo (k), mega (M), giga (G), tera (T)	As set out in the ASE publication *Signs, Symbols and Systematics* (*The ASE Companion to 16–19 Science*, 2000).
(f)	the conventions used for labelling graph axes and table columns.	As set out in above, e.g. speed / m s^{-1}. HSW8

(6) M - Recall the SI quantities and their units
(7) S - Show an understanding of orders of magnitude, prefixes and convert units
(8) C - Be able to estimates of a range of quantities, with a justification.

Course and assessment overview

Paper		Marks	Duration	Weighting
Paper 1	**Modelling physics** Content – Modules 1, 2, 3, 5	**100**	2 hr 15 mins	37%
	Section A – Multiple choice	15		
	Section B – Structured questions, covering theory and practical skills	85		
Paper 2	**Exploring physics** Content – Modules 1, 2, 4, 6	**100**	2 hr 15 mins	37%
	Section A – Multiple choice	15		
	Section B – Structured questions, covering theory and practical skills	85		
Paper 3	**Unified physics** Content – all modules	**70**	1 hr 30 mins	26%
	Structured questions and extended response questions covering theory and practical skills	70		
Non-exam assessment	**Practical endorsement for physics**	Pass/Fail	Non-exam assessment	Reported separately
	See pages 29-31. Teacher-assessed component common to Physics A and Physics B (Advancing Physics). Candidates complete a minimum of 12 practical activities to demonstrate practical competence. Performance reported separately to the A Level grade. Moderation details still to be confirmed by Ofqual at the time of going to press	Reported separately		

Module 1: Development of practical skills in physics (taught through Year 12 and Year 13)

Skills of planning, implementing, analysis and evaluation.

Module 2: Foundations of Physics (taught through Year 12 and Year 13)

Physical quantities and units, scalars and vectors, measurements.

Module 3: Forces and motion (Year 12)

Motion; Forces in action; Work, energy and power; Materials; Newton's laws of motion and momer

Module 4: Electrons, waves and photons (Year 12)

Charge and current; Energy, power and resistance; Electrical circuits; Waves; Quantum physics.

Module 5: Newtonian world and astrophysics (Year 13)

Thermal physics; Circular motion; Oscillations; Gravitational Fields; Astrophysics.

Module 6: Particles and medical physics (Year 13)

Capacitors; Electric fields; Electromagnetism; Nuclear and particle physics; Medical imaging.

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Learning expectations

Folders / books

- Assessment sheets at front (completed after each assessment)
- Topic checklist/spec
- Sheets and assessment - bound into folder in sections
- Write full and proper notes
- Show **full** working
- Diagrams drawn with a pencil and ruler
- Revision notes for each topic
- Ensure you are up to date for termly folder checks.

Lessons

- Bags and coats in the bag rack
- Complete all work to the best of your ability
- Seek advice and question everything
- Use resources on student portal and **kerboodle** (exam papers, revision materials, lesson notebook files)
- Pens, ruler, pencil, calculator

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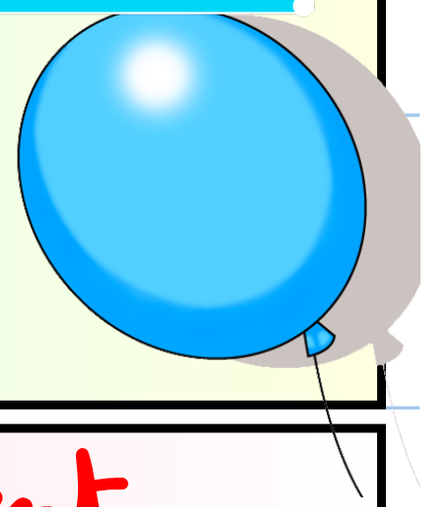
Quantities and units


Key point

STARTER: Physical quantities are a property of an object or system that can be measured.
Quantities have a numerical value and a unit.



Kilo 10^3

Mega 10^6

Giga 10^9

Mass Length Current Time

Why are units so important?


Key point

Which ones are **base quantities** and are **fundamental** and cannot be derived from other quantities?

What are their **base units**?

mars climate orbiter 2

(6) M - Recall the SI quantities and their units
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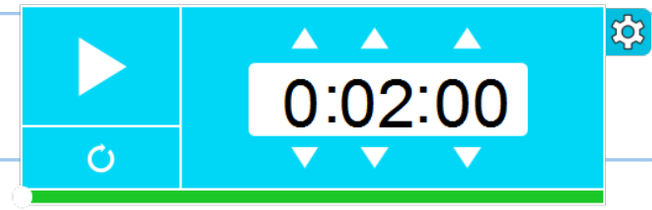
SI Base quantities.




Key point

Quantity	Base unit	Unit symbol
length	metre	m
mass	kilogram	kg
time	second	s
electric current	ampère	A
temperature	kelvin	K
amount of substance	mole	mol

How did scientist come up with these particular units?

derivation of units for SI quantities

the roundest object

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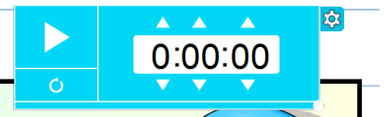
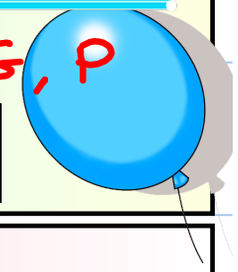
Prefixes → kg ← unit



Activity: How big / small are these prefixes? c, m, n, M, p, K, T, M, G, P

Make a table to hold their: Symbol, name and power of 10 they represent.



Kilo 10^3

Mega 10^6 Are there any other prefixes to quantities?

Giga 10^9

Microscopic scale (small prefix)	Macroscopic scale (usually capital prefix)
f femto, f x10^{-15}	P x10^{15} peta, P
p pico, px10^{-12}	T x10^{12} tera, T
n nano, nx10^{-9}	G x10^{9} giga, G
μ micro, μx10^{-6}	M x10^{6} mega, M
m milli, mx10^{-3}	k x10^{3} kilo, k
c cen	

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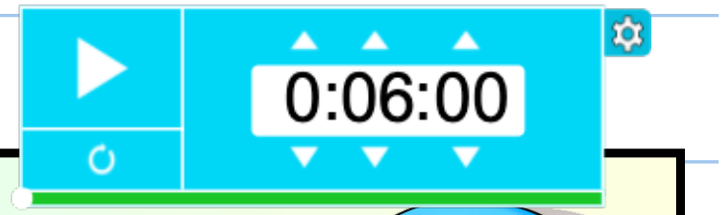
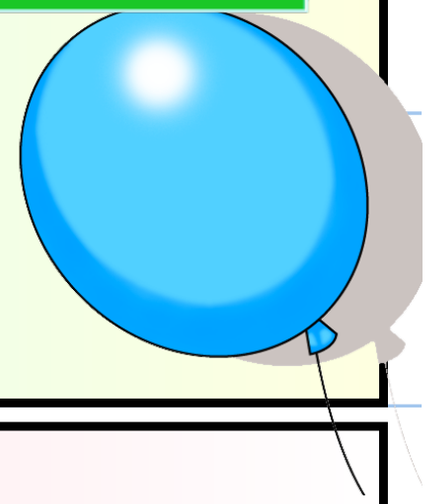
Orders of magnitude




Key point

Activity: Complete the worksheet on orders of magnitude



Kilo 10^3

Mega 10^6

Giga 10^9

How will you ensure that you always check the unit and order of magnitude?

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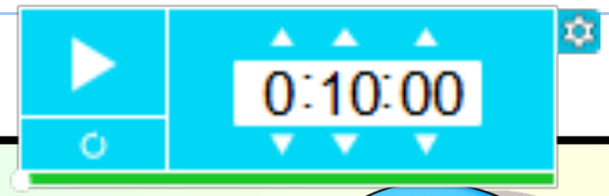
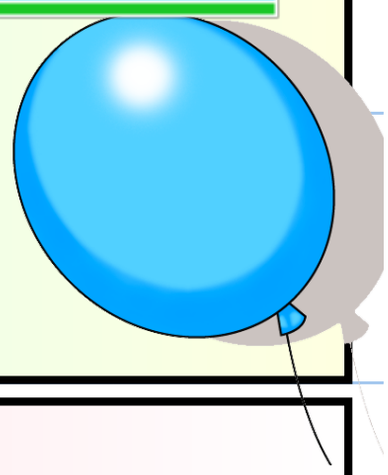
Estimation in physics




Key point

Activity: In pairs make a rough but reasoned estimate of the quantities on the sheet.

How thick is a piece of paper?



Kilo 10^3

Mega 10^6 Extension estimate below....

Giga 10^9 Why is estimation important to physics?

'How many pingpong balls fit in this room?'

How thick is a piece of paper?

How many hairs on a human head?'

How many teaspoons of water in the pond?'

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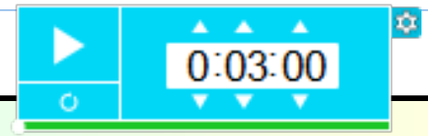

Plenary

3. facts you have learned this lesson
2. things you have been reminded of this lesson
1. way of working or thinking that you aim to continue during the physics course.

a) ~~1×10^{-3} m~~ 0.1×10^{-3} 1×10^{-4} ✓

d) ~~4.6×10^{-12}~~ 0.46×10^{-9} ⓝ 4.6×10^{-10} ✓

0.65 micrometers in m,

1600m in mm

55A in pA